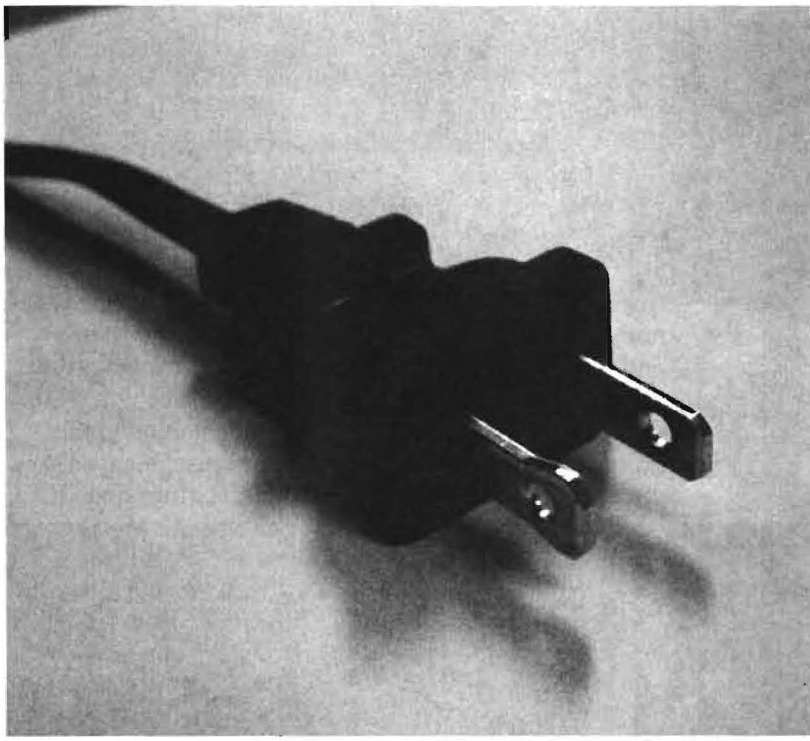
The Three Most Common Electrical Safety Issues in Deployed Environments

BY JAMES F. JENNINGS

The U.S. standard voltage of 120 creates problems for Soldiers deployed to countries where the standard voltage is 220. Ignorance and carelessness when working with these voltages can have disastrous results.

Electrical safety problems have bedeviled deployed U.S. military forces for many years. Since 2008, electrocutions and electrical fires in Southwest Asia have been front page news in the *New York Times* and leading stories on CNN. Electrocutions of deployed Soldiers were the focus of congressional hearings in 2009, and the Department of Defense Inspector General (DOD IG) conducted three investigations the same year to determine the scope of the problem and recommend solutions.

A key finding of the DOD IG report on electrical safety problems in Afghanistan was "a lack of education for service members regarding electrical safety, incident reporting, and personal responsibility." (This report is available online at www.dodig.mil/SPO/Reports/D2009-SPO-005%20FINAL_web.pdf.) The report recommends training to resolve these issues and prevent future electrocutions, electrical shocks, and fires. This article, which draws on the author's experience as a safety officer in Bosnia, Kosovo, Iraq, and Afghanistan, discusses the three most common electrical safety issues for forces deployed in support of overseas contingency operations: grounding, unauthorized power strips, and different voltages.



Unlike devices in most other countries, most U.S. electronic devices use 120 volts. Their plugs have two blades (type A) or two blades and a grounding prong (type B).

Grounding

Any safety professional or electrician who has worked overseas will immediately highlight poor or nonexistent grounding as the most serious electrical safety issue facing a deployed force. U.S. military units often occupy existing facilities that are wired to local standards, if such standards exist. Unlike the United States, Canada, Australia, or Western Europe, many areas in which our troops are located have little to no oversight to ensure electricians are qualified or certified. Grounding, which is generally considered by Western standards to be the most important aspect of electrical installation and operation, is not a common practice in many countries in Southwest Asia. This is partly because of the poor grounding qualities of sandy soil.

Color coding wires, a standard procedure in Western countries, is often ignored in Southwest Asia. In many cases, any available wire, regardless of color, is used. U.S. military and contractor electricians often have difficulty determining which wire is the ungrounded, grounded (neutral), or grounding conductor.

Actions by military personnel, usually caused by ignorance, compound the grounding problem. These

Stripping wires and putting them into outlets is a common method of bypassing adapters. It is illegal and extremely dangerous.

actions include snipping off grounding prongs on plugs, cutting and splicing electrical wires, jury-rigging or altering circuit breaker panels, and failing to properly ground generators.

The 3 January 2008 electrocution of Staff Sergeant Ryan Maseth of the 5th Special Forces Group while he was taking a shower in the Radwaniyah Palace Base Complex in Baghdad, Iraq, tragically highlighted the grounding problem. The hot-water heater, installed by Iraqi electricians before the arrival of U.S. forces, was not grounded, and the circuit breaker panel was inoperable. Staff Sergeant Maseth was electrocuted in the shower when a short in the water pump electrified the water. The stray amperage was not channeled to the ground through a grounding wire because one was not installed. Subsequent congressional hearings and DOD IG reports focused attention on the problem.

Through a quickly executed contract, dozens of U.S.-trained and -certified master electricians were sent to Iraq and Afghanistan to fix electrical deficiencies. Task Force for Safety Actions for Fire and Electricity (TF SAFE) in Iraq and Task Force Protecting Our Warfighters and Electrical Resources (TF POWER) in Afghanistan were established to provide resources, tracking, and command attention to the problems.

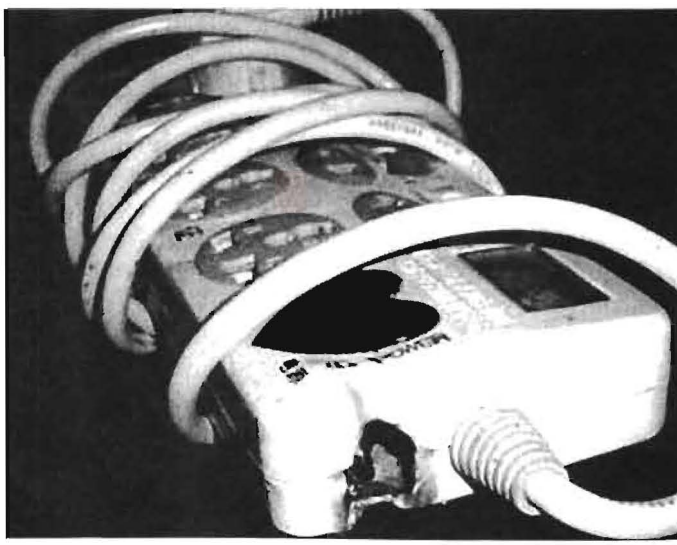
The IG reports identified 19 instances of electrocution in Southwest Asia. Although this full-court press mitigated thousands of life-threatening electrical hazards, the grounding problem remains. The continued use of local electricians by subcontractors and military units seeking ways to cut construction costs is a problem. Soldiers who ignore electrical standards or bypass grounds, especially in living areas, perpetuate the danger of electrocutions and fires.

Oversight by safety personnel is a partial answer to the grounding problem, but having engaged first-line supervisors—usually junior sergeants, who know what "wrong" looks like because they conduct unannounced inspections of living areas—is the most effective solution. "A First-Line Supervisor's Safety Inspection Guide for Deployed Living and Work Areas" is a reference published by the 101st Sustainment Brigade in 2009. It is available to download at the Army Combat Readiness/Safety Center website at https://safety.army.mil/LinkClick.aspx?fileticket=Ds2ULm5fPD4%3D&tabid=654.

Unauthorized Power Strips

Although standard operating procedures in Iraq and Afghanistan mandate the countrywide use of electrical components approved by Underwriters Laboratories (UL), the Canadian Standards Association (CSA), or the European Economic Community's European Conformity/Conformité Européenne (CE), poorly manufactured power strips continue to present major fire hazards in deployed environments.

The primary source for these unsafe power strips is China. The China Compulsory Certification (CCC) logo is intended to be a quality control standard. However, electrical power strips with the CCC logo have consistently been shown to be of poor quality and often catch on fire. Chinese power strips are usually made of very thin plastic, have internal metal components that quickly loosen with use, and have extremely small wire gauges that are unsuitable for the amperage the strip can draw.



This Chinese adapter has multiple sockets. Although these types of adapters are handy, they are poorly constructed and easily catch fire, despite the fuse built into the component. The fuse in this adapter did not prevent the fire.

Hundreds of fires have been caused by Chinese power strips. When multiple high-amperage items are plugged in, the strips often melt down and ignite a fire. Chinese manufacturers have become skilled at counterfeiting and applying UL and CE logos, frustrating safety and fire professionals when procurement personnel purchase items locally that appear to comply with the UL or CE standards.

The primary reason U.S. military personnel purchase and use Chinese power strips is their multiple-use outlets. Soldiers are familiar with the National Electrical Manufacturers Association type A and type B plugs, the standard American two-blade plug. (Type A has no grounding prong; type B has one.) Those who are serving or have served in Europe are familiar with the type C, E, and F prong-style plugs. (For an excellent summary of plug configurations, see http://en.wikipedia.org/wiki/Electrical_plug.) However, the type G, or British Standard 1363 plug, is widely used in Southwest Asia. Soldiers are often mystified by the various plugs and outlets.

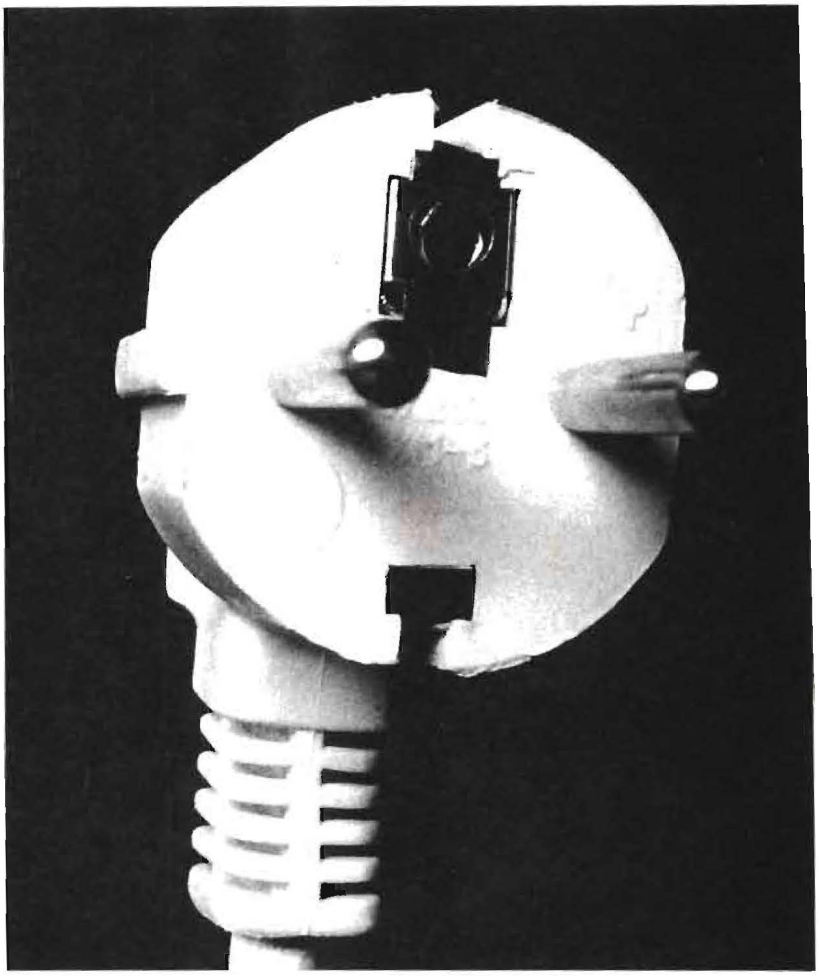
Although the Army and Air Force Exchange Service post exchanges carry only UL- and CE-approved power strips and adapters, many of the outlying operating bases and outposts have limited access to the safe, approved versions. Unfortunately, local vendors usually only carry the Chinese strips. Units in outlying areas have a vested interest in keeping money flowing through the local area, and most outposts have a small shop or two operated by local merchants.

Education, Training, and Oversight

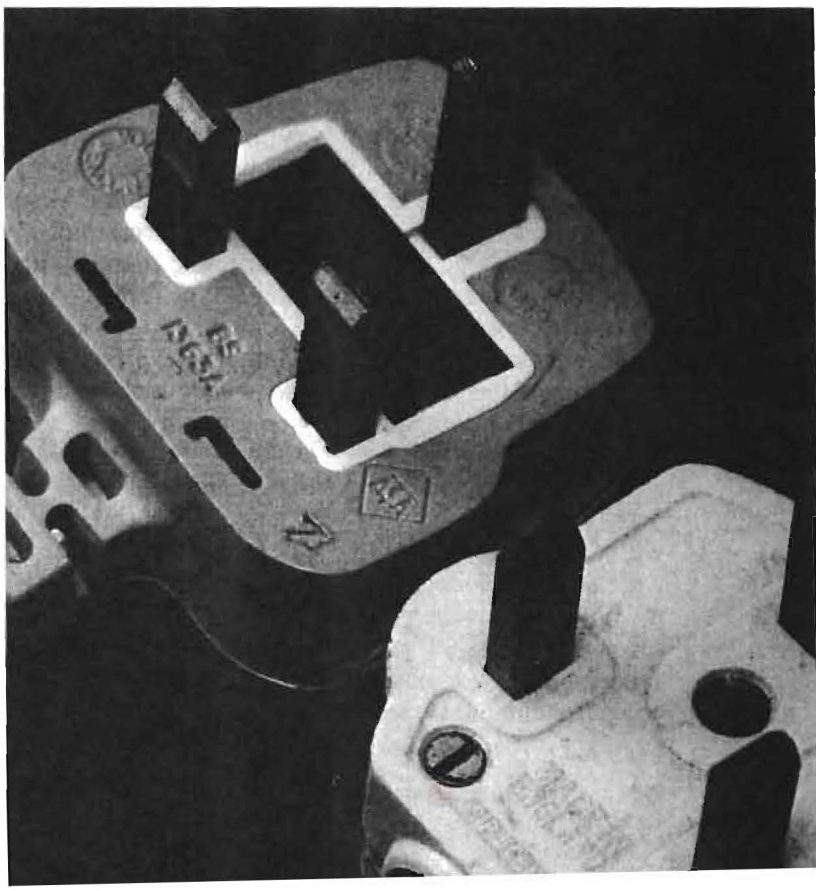
The problem is twofold. As identified in the DOD IG report, the average military member is unaware of the different types of plugs and their capabilities and limitations. Removing grounding prongs and plugging 110-volt equipment into a 220-volt circuit are usually the result of ignorance, not a willful desire to break the safety rules. In many cases, an unsatisfactory response to the use of the unsafe Chinese power strip is, "It was there when I got here."

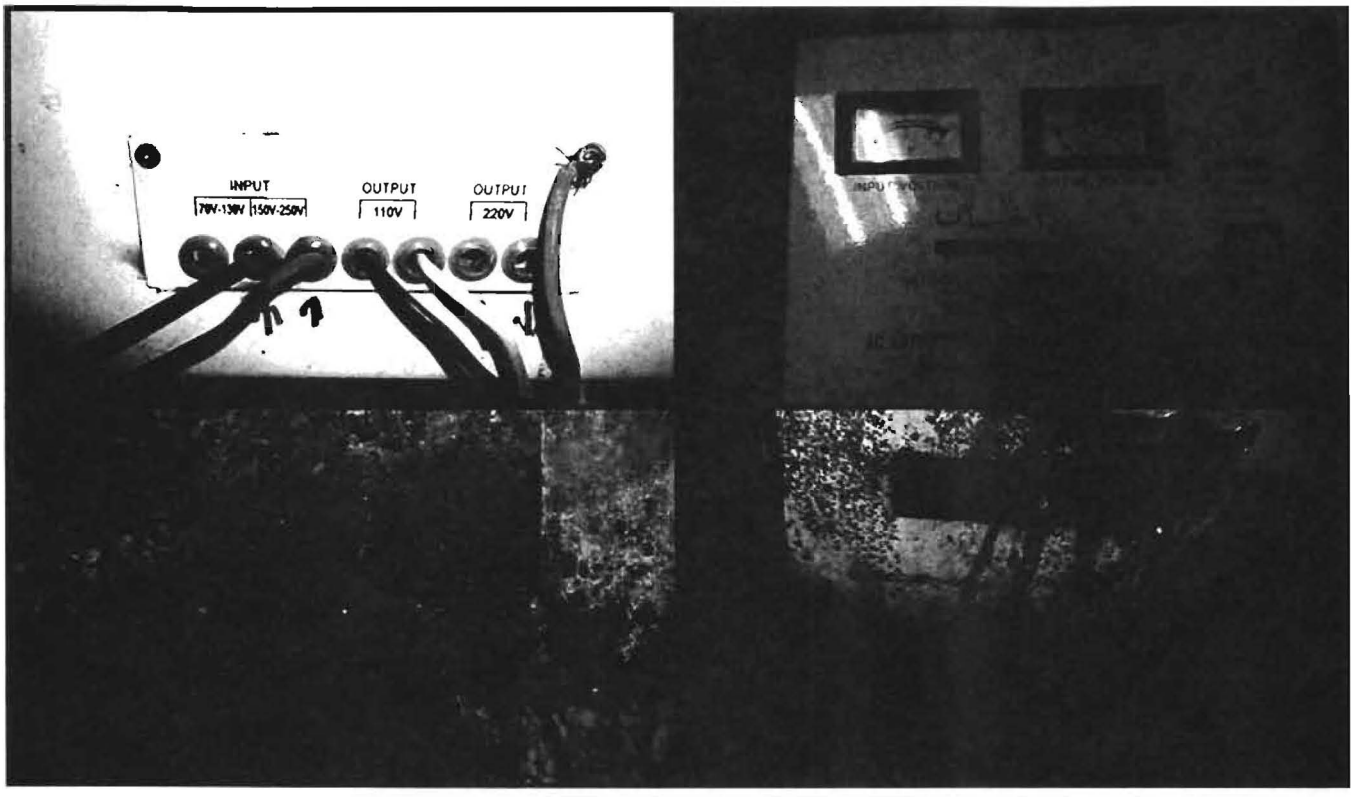
The solution is similar to the grounding problem: education, training, and oversight. A proactive safety professional, with the backing of the commander to schedule time on the predeployment training calendar, is the key to educating and training Soldiers. After arriving in theater, periodic inspections by first-line supervisors, especially in living areas, will reveal if unsafe power strips are hidden and present a fire hazard.

This problem also can be mitigated by purchasing and shipping UL-approved power strips and adapters before deploying. Pre-mission planning by the unit safety officer or staff engineer must include an assessment of the anticipated need for electrical power strips, which often can be met by stocking the supply CONEX (container express) with power strips before shipment overseas.



Above, this is a type E or F Europlug with ground. Types D, E, and F are very similar. Below, type G British Standard 1363 plugs are often found in Southwest Asia. A fuse below the red cover will blow and protect the circuit.





This non-CE certified step-up/down voltage transformer and regulator was the cause of a fire at an operating base in Afghanistan. Procuring safe transformers is difficult since most are not CE approved and many have counterfeit CE logos applied by Chinese manufacturers.

Different Voltages

With the completion of the military drawdown in Iraq, the 110 volts versus 220 volts problem has virtually disappeared since Iraq has a 220-volt electrical system and Soldiers in Afghanistan are usually on a 110-volt grid (even though the Afghan commercial standard—where there is electricity—is 220 volts).

Base camps constructed by European nations usually use the 220-volt standard, so U.S. military personnel on those camps must be aware of the differences. Many Soldiers discovered the hard way during their initial deployment to Iraq that although a simple adapter will allow one to insert a U.S. blade-style type A or B plug into a two-prong type C, E, or F outlet, doing so can damage the equipment plugged into it. The primary casualties of this lack of knowledge were U.S.-built 110-volt-only printers, which were often fried by 220-volt outlets.

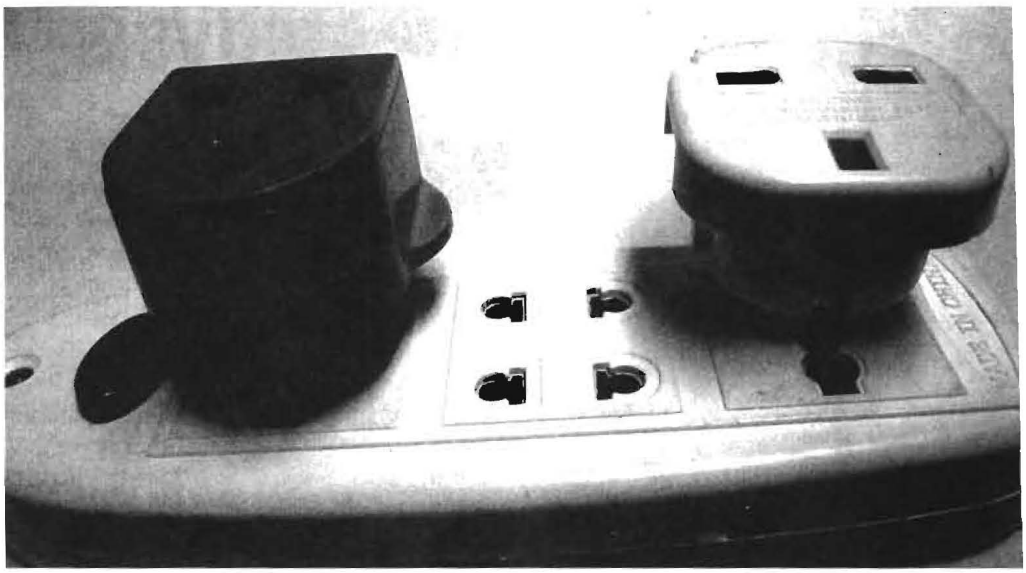
Virtually every unit experienced some kind of adverse event involving 220-volt outlets; most ended up with a smoking, burning piece of electrical equipment, with a dumbfounded private first class standing beside it wondering how he would explain this to the first sergeant.

I personally witnessed a Soldier plug in a desktop computer without switching the red tab on the back from the 110 to the 220 setting. The wisp of smoke and audible pop were the result of the fuse blowing, protecting the machine as designed. It was quite a while before a replacement fuse could be ordered and sent from the United States, however, and the computer was useless in the interim. (The Soldier who made that error was a sergeant first class, not a private.)

The 101st Sustainment Brigade produced a 12-minute video summarizing these electrical challenges, which is posted at the Army Combat Readiness/Safety Center website at https://safety.army.mil/multimedia/VIDEOLIBRARY/VideoPlayer/TabId/421/VideoId/213/Electrical-Safety-In-Iraq.aspx.

To prevent confusion, many units marked each outlet with "110 V" or "220 V," but these labels or magic marker scribbles often fade or disappear over time. In one case, a contractor wired 220-volt service into an outlet with the U.S. type B blade-style plug-in, which caused a great deal of confusion and a few more fried components.

Step-up/down voltage transformers provide a solution, but the primary source for these appliances is—you guessed it—China. After electricians employed by a U.S. contractor in Afghanistan inspected new locally-purchased step-up/down transformers, they were determined to be unsafe. Manufactured in China,



Chinese power strips are often poorly constructed and easily catch on fire. However, their multiuse outlet configurations make them very appealing. They are not UL or CE approved and are not allowed on U.S. military facilities in Southwest Asia.

they included a counterfeit CE logo carefully stenciled on the side. A visit to the company website revealed a link to the CE certificate—a handsome piece of paper with fancy script suitable for framing. It was counterfeit; there was no CE approval.

When an electrician checked the transformer schematic posted on the website, he determined that the ground was insufficient and the product presented a serious fire and shock hazard. A Google search for "unsafe Chinese transformers" reveals a wide variety of perspectives, with most experts advising caution when purchasing Chinese electrical products and many highlighting the widespread counterfeit certification problem.

The primary solution to the 110 volts versus 220 volts problem, again, is education and training. Soldiers must be trained on the differences between the two electrical systems. The hazard of using adapters is a key part of this education process, and marking outlets is an excellent practice. Determining whether a step-up/down power transformer is suitable for use is a more difficult problem. A blanket rule of "don't buy Chinese products" is not feasible since most Chinese goods are safe despite widespread publicity to the contrary in recent years. Purchasing American-manufactured transformers ensures excellent quality control, but they are difficult to find because they are not in high demand in the United States.

Most electrical safety issues in deployed environments can be solved with education and training. U.S. military personnel who have not been stationed overseas do not normally have extensive exposure to different electrical systems. Many are completely unaware that other countries have different voltages. Few know about UL or CE certifications. The addition of full-time civilian safety professionals on brigade staffs creates an excellent resource for educating and training Soldiers on these key issues.

Training must not begin when Soldiers arrive in theater; it must be part of the predeployment process. Since the weeks before deployment are a blur of activity, command emphasis may be needed to ensure that time is set aside for electrical safety training. Periodic refresher training sessions while deployed sustain awareness and combat complacency. Procurement personnel and S–4s also must be educated about the UL and CE certification requirements because they should be able to cut off local purchases that provide an entry route for unsafe electrical equipment.

Last and most importantly, unannounced inspections of living and work areas will identify unsafe practices and eliminate unsafe electrical components. First-line noncommissioned officer leadership and supervision, with the continuous assistance of safety professionals, is the key to successful mitigation of electrical fires, shocks, and electrocutions.

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